## REMARKS

Claims 1-5, 7-9 and 11-18 are pending in the present Application. Claims 1-3 remain withdrawn, and Claims 16-18 have been allowed, leaving Claims 4, 5, 7-9 and 11-15 for consideration upon entry of the present amendment.

Claim Rejections Under 35 U.S.C. § 103(a)

Claims 4-5, 7-9 are rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over Muraoka, U.S. Patent No. 6,699,330 (hereinafter "Muraoka"). Applicants respectfully traverse this rejection.

Claims 11 and 12 are rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over Muraoka in view of Mei et al., U.S. Patent No. 6,864,529 (hereinafter "Mei").

Claims 13-15 are rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over Muraoka in view of Mei and further in view of Degendt et al., U.S. Patent Application Publication No. 2002/0088478 (hereinafter "Degendt"). Applicants respectfully traverse these rejections.

In sustaining the rejection, the Examiner has stated that "Muraoka teaches ozone concentration in the acetic acid is 200 PPM or higher (Col. 7, lines 10 – 22) and futher as discussed above in the Claim 4 rejection section, different concentration of ozone is considered to be effective result variables of thickness, etching rate, times and etc." (See Office Action dated 06-25-2010, page 7) The Applicants respectfully disagree.

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing that all elements of the invention are disclosed in the prior art; that the prior art relied upon, or knowledge generally available in the art at the time of the invention, must provide some suggestion or incentive that would have motivated the skilled artisan to modify a reference or combined references. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988). "A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR Int'l Co. v. Teleflex Inc.,* 127 S.Ct. 1727, 1741 (2007). To find obviousness, the Examiner must "identify a reason that would have prompted a person of ordinary skill in the art in the relevant field to combine the elements in the way the claimed new invention does." *Id.*

Claim 4 is directed to a method of forming a pattern, the method comprising forming a

photoresist pattern including novolak on a layer formed on a substrate; etching the layer using the photoresist pattern using as a mask to form a pattern on the substrate; and removing the photoresist pattern using a stripping composition including an acetic acid and an ozone gas included in the acetic acid in the form of a bubble, wherein a pH of the stripping composition is about 1.6 to about 5, and wherein a concentration of the ozone gas included in the acetic acid is about 80,000 to about 90,000 ppm.

Muraoka discloses and claims a method of forming a pattern, the method comprising forming a photoresist pattern (Col. 16, lines 37-40, FIG. 7), including novolak on a layer formed on a substrate; etching the layer using the photoresist pattern using as a mask to form a pattern on the substrate; and removing the photoresist pattern (Col. 16, lines 50-55) using a stripping composition including an acetic acid and an ozone gas (Col. 16, lines 44-50) included in the acetic acid in the form of a bubble (Col. 16, lines 45-65), wherein a pH of the stripping composition is about 1.6 to about 5 (inherent properties of disclosure of Muraoka).

Muraoka discloses, in Col. 16, lines 45-65 (cited by the Examiner):

> The ozone acetic acid reached the highest ozone concentration 380 mg/L in about 5 minutes when about 300 mL of acetic acid was put into the ozone absorption container **42** and nitrogen-containing oxygen with an ozone concentration of 220 mg/L was exhalated from ozone exhalator at a flow rate of 1 L/minute to effect bubbling. The wafer **56** was rotated at 1,000 rpm and the ozone acetic acid was released from the nozzle **82** at a rate of 1.5 mL/second, whereupon the resist of the whole surface was stripped in 15 seconds in the naked eye examination. The ozone acetic acid was further continued to be released for 20 seconds, and the acetic acid held in the acetic acid container **93** was released from the nozzle **84** at a rate of 1.5 mL/minute to effect rinsing for 10 seconds. Then the rotation of the wafer was increased to 4,000 rpm to effect spin drying for 30 seconds.

Muraoka shows data that correlate stripping rate and ozone concentration to concentrations of acetic acid of 50 to 100 wt%. FIG 6, x-axis.

Muraoka discloses exemplary apparatuses and accompanying processes for removing the impurities with respect to FIGs. 1 and 7. FIG. 1 shows ozone treating bath 7 and quartz glass pipe 18 through which ozone is introduced into the bath 7 filled with acetic acid, so that the ozone

concentration in acetic acid reached 200 ppm or higher in 5 minutes. (Col. 10, lines 3-8.)

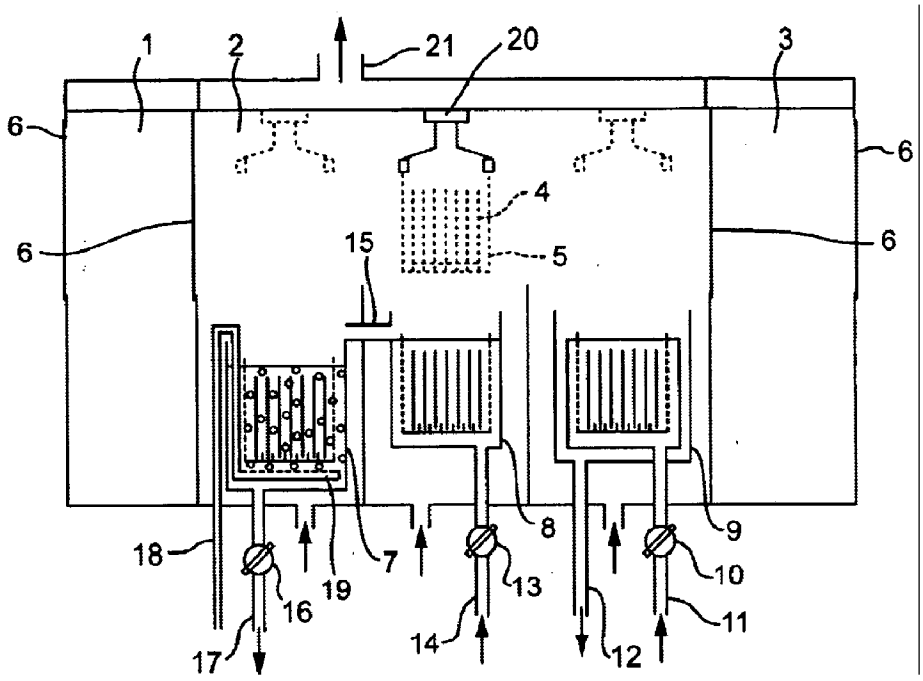



FIG. 1 (Muraoka)

Then, carrier 5 holding wafers 4, attached to robot arm 20, is immersed in the ozone treating bath 7 (in which the ozone concentration is 200 ppm or higher) for 1 minute. Col. 10, lines 9-13. Reading Muraoka in view of this disclosure, the stepwise nature of this process will readily be appreciated by the skilled artisan, where the ozone concentration of 200 ppm is reached after bubbling ozone through the acetic acid solution for 5 minutes, after which ozone bubbling ceases and the wafers are immersed in the resulting saturated ozone/acetic acid solution (having an ozone concentration of 200 ppm, to a maximum of almost 400 ppm).

There is no suggestion or incentive in the disclosure of Muraoka for immersing the wafers for cleaning in the ozone treating bath 7 while bubbling is underway, as this would run contrary to the *entirety* of the disclosure of Muraoka. Muraoka, as explained above, discloses contacting a *saturated* solution of ozone in acetic acid to a wafer where the greatest possible concentration of ozone is "nearly 400 ppm." This is seen in the Figure 6 as well and will be discussed in detail later.

The skilled artisan will appreciate a higher amount would not be possible to achieve without changing the principle of operation of Muraoka to actually bubble ozone at a high rate

*concurrent with* immersion of the wafers, as this amount represents a practical upper limit for a saturated solution ozone concentration required by the disclosure of Muraoka. The Examiner's assertions notwithstanding, there is no indication whatsoever that Muraoka, in either a specific passage or *as a whole,* discloses bubbling ozone through a stripping solution while immersing e.g., a photoresist-coated wafer; this assertion by the Examiner is simply not supported by the disclosure of Muraoka. In applying Section 103, the U.S. Court of Appeals for the Federal Circuit has consistently held that one must consider both the invention and the prior art "as a whole", not from improper hindsight gained from consideration of the claimed invention. See, *Interconnect Planning Corp. v. Feil,* 227 U.S.P.Q. 543, 551 (Fed. Cir. 1985) and cases cited therein. According to the *Interconnect* court

> [n]ot only must the claimed invention as a whole be evaluated, but so also must the references as a whole, so that their teachings are applied in the context of their significance to a technician at the time - a technician without our knowledge of the solution.

*Id.* Also critical to this Section 103 analysis is that understanding of "particular results" achieved by the invention. *Id.*

When, as here, the Section 103 rejection was based on selective combination of the prior art references to allegedly render a subsequent invention obvious, "there must be some reason for the combination other than the hind sight gleaned from the invention itself." *Id.* Stated in another way, "[i]t is impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious." *In re Fritch* 23 U.S.P.Q.2d 1780, 1784 (Fed. Cir. 1992).

Further, FIG. 7 of Muraoka shows an apparatus for dispense of ozone acetic acid solution on a spinning wafer on a wafer chuck:

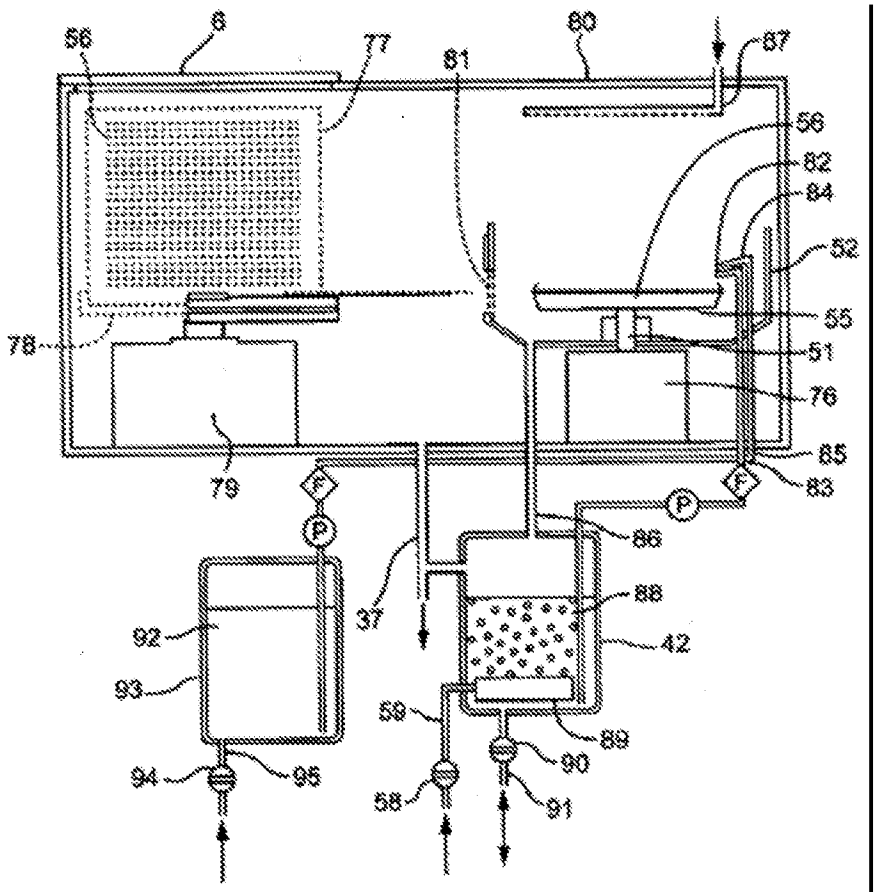



Fig. 7

The Examiner states in the Office Action on p. 3, section 2, 2nd paragraph, that Muraoka discloses use of ozone in bubble form, citing Col. 16, lines 44-65 of Muraoka. Applicants note the portion of Muraoka cited by the Examiner is part of the discussion of Example 13, which refers to the function of apparatus of FIG. 7. Applicants respectfully disagree with the Examiner's conclusion that Claim 4, particularly as amended to include the limitations of Claim 6, is substantially identical to the process of Muraoka, and assert that this conclusion stems from an incorrect reading of Muraoka which ignores the entirety of the disclosure of Muraoka.

In Example 13 (see FIG. 7), Muraoka discloses that "ozone acetic acid solution can be prepared by sending ozone gas into acetic acid 88 held in an ozone absorption container 42, from an ozone exhalator 89…through a pipe 59 having a valve" and that "gas-feeding for 5 minutes makes ozone concentration become saturated." The portion cited by the Examiner then adds that

"the ozone acetic acid reached the highest ozone concentration 380 mg/L [i.e., 380 ppm] in about 5 minutes when about 300 mL of acetic acid was put into the ozone absorption container 42 and nitrogen-containing oxygen with an ozone concentration of 220 mg/L was exhalated from ozone exhalator [89] at a flow rate of 1L/min to effect bubbling." Col. 16, lines 44-49. This is reproduced below for the Examiner's convenience.

It will be appreciated that this section clearly discloses preparation of a saturated solution of ozone acetic acid; the skilled artisan will readily appreciate that in order to saturate the acetic acid solution of a liquid with a gas, it is necessary to bubble the gas through the liquid; in this case, for a total of 5 minutes. However, Muraoka then discloses dispense of the *saturated* ozone acetic acid solution which is "released from a nozzle 82 at a rate of 1.5 mL/second" to strip the photoresist from the wafer." While Muraoka does not disclose in this section that the solution could somehow possibly still be bubbling or include bubbles, Muraoka does clearly teach, in the Specification in general and consistent with the inventive concept of Muraoka, and contrary to the Examiner's position, a smoothly flowing dispense of a saturated solution, that the ozone is *dissolved* in the solvent (Col. 4, lines 6-12; emphasis added); that the stripping composition is used as a "running film" over the surface to be stripped, and is replenished constantly or at intervals (Col. 4, lines 13-23); and that Muraoka, as Applicants have previously pointed out, only teaches bubbling ozone through a glass filter into the solution to reach a concentration close to saturation, and with enhancement, "up to nearly 400 ppm". Col. 7, 24-27.

Muraoka thus does not disclose stripping a wafer with ozone in bubble form as claimed in Claim 4, but discloses only bubbling ozone through acetic acid to saturate the solution to a maximum concentration of 380 ppm ozone, *then* applying a saturated solution of ozone acetic acid to a photoresist to be stripped, either by dispensing the saturated solution onto the wafer to be stripped (as in FIG. 7) or immersing a boat of wafers in a saturated ozone acetic acid bath to strip the wafers (as in FIG. 1).

Furthermore, as already noted, the maximum ozone concentration of the composition disclosed by Muraoka is about 380 mg/L (ppm; see Col. 16, supra). This may be seen in the description of the FIG. 6 and column 15 of the Muraoka, both of which are reproduced below for the Examiner's convenience.

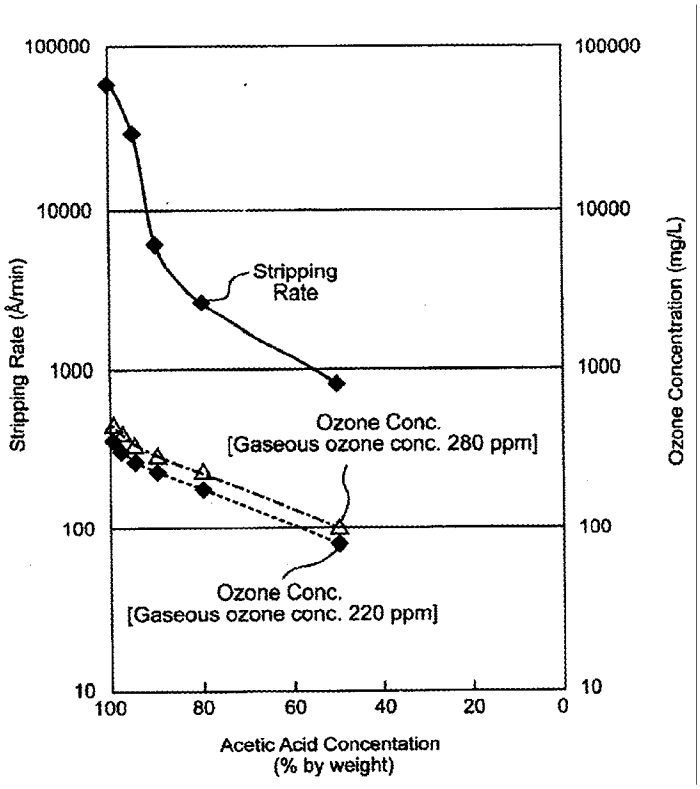
<column 15 of Muraoka>

> As can be seen from FIG. **6**, when ozone gas with a ozone concentration of 220 mg/L is used, ozone saturation quantity is 380 mg/L and the stripping rate of acetic acid with a purity of 98% or higher against the novolak resin resist IX555 reaches as high as 6 $\mu$m/minute or more. Thus, in the present invention, where the ozone concentration in acetic acid is close to 400 mg/L, a resist film with a thickness of 1.5 $\mu$m can be removed in a very short time of about 15 seconds.

From the paragraph above, it is clear that while Muraoka describes concentrations of ozone in acetic acid of 200 ppm or greater, it does not tech ozone concentrations greater than 400 ppm. In Col. 15 as reproduced above, Muraoka teaches maximum concentrations of 380 ppm.

Similarly with regard to the Figure 6, (reproduced with associated text below for the Examiner's convenience), it is clear that the maximum concentration disclosed by Muraoka is less than 400 ppm.

> FIG. **6** shows the relationship between acetic acid concentration of hydrous acetic acid and saturated ozone concentration (dotted line: ozone concentration of 220 ppm; dotted chain line: ozone concentration of 280 ppm), and the relationship between acetic acid concentration of ozone-saturated hydrous acetic acid and stripping rate against a novolak resin resist (solid line).




However, the ozone concentration of a composition as claimed is about 80,000 to 90,000 ppm, which is *significantly* higher than that used by Muraoka, and therefore implicitly indicates to the skilled artisan that the process is necessarily different. In particular, such an ozone concentration would not be possible for a saturated solution as disclosed in Muraoka, and for which Muraoka clearly indicates a maximum of 380 ppm ozone, but would only be possible with the presence of ozone in another form, i.e., in bubble form, by bubbling ozone during the cleaning process.

Regarding Claim 4, the Examiner alleges that it would have been obvious to one of ordinary skill in the art to use a general concentration of ozone gas included in acetic acid because it is not inventive to discover the optimum or workable range by routine experimentation. Applicants vigorously disagree, and contend that the Examiner has not appreciated from the disclosure of Muraoka that within the confines of the operating principles of Muraoka (i.e., use of a saturated solution of no greater than 380 mg/L (i.e., 380 ppm)), Muraoka does not even contemplate the vastly greater concentrations of ozone claimed by Applicants, of 80,000 to 90,000

ppm. It is simply not possible, given the operating principle and process constraints of Muraoka, to achieve these concentrations without destroying the intent of Muraoka. To modify Muraoka to include such a high level of ozone, present in bubble form, would destroy the intent of the reference by both changing the principle of operation of Muraoka, and rendering it unsatisfactory for its intended purpose. In this regard, the courts have held that '[i]f the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious.'" *In re Ratti* 270 F. 2d 810, 123 USPQ 349 (CCPA 1959). The courts have also held that "[i]f the proposed modification would render the prior art invention being modified unsatisfactorily for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon* 733 F. 2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

Muraoka, as noted previously, extensively discloses a flowing film solution process using exclusively a solution of ozone *dissolved* in acetic acid (which by definition does not include bubbles). Applicants' process discloses a much higher concentration of ozone in bubble form as claimed in Claim 4 which in providing ozone in both the gas phase and solution phase is conceptually completely different from the method of Muraoka which solely relies on ozone in the solution phase, and thus cannot fairly be said to be taught by the solutions of Muraoka.

Because Muraoka does not disclose the use of ozone in bubble form for stripping, it does not disclose all elements of instant Claim 4. Muraoka's process operates at ambient pressure and maintains ozone concentration near the saturation limit of "nearly 400 ppm" for the ozone acetic acid/solvent solution. It would not be possible, based on the teachings of the disclosure of Muraoka, to create a solution with the extremely high ozone levels (i.e., as claimed in instant Claim 4 of 80,000 to 90,000 ppm; over 300-400 times higher than in Muraoka) without the use of ozone in bubble form in the stripping solution as claimed in Claim 4; Muraoka would then necessarily be using a bubbling solution of ozone in acetic acid.

Modifying Muraoka to use ozone bubbles would completely change the principle of operation of the Muraoka which is predicated on a smooth dispense on or across a wafer surface, and where inclusion of bubbles would interfere with such a dispense and wash motif. The Examiner must appreciate that inclusion of ozone bubbles would require a completely different dispense and stripping process (and apparatus; see e.g., Muraoka, FIGs. 1 and 7) for Muraoka in

order to accommodate limitations of the method claimed in instant Claim 4. There is no suggestion or evidence in Muraoka that doing so would be successful, since all the stripping data of Muraoka is based on the use of a saturated solution (see e.g., Muraoka, FIG. 6), and therefore Muraoka fails to provide a suggestion or incentive that would lead one skilled in the art to modify the references to provide the process of Claim 4 as amended.

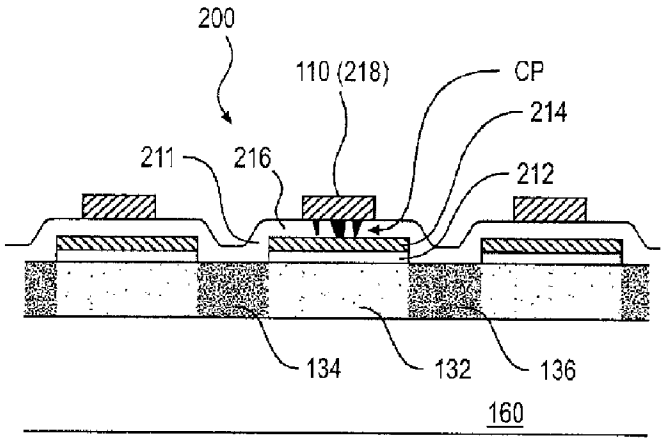
As noted previously, Applicants respectfully but specifically traverse the Examiner's statement that use of a high ozone concentration is mere optimization of conditions. MPEP 2144.05, referenced by the Examiner, deals with criticality of range and is generally applied where the range is close or overlapping. Such is manifestly not the case here; as noted above, the ranges of the cited art and that of the instant claim differ by two orders of magnitude, well above any arguable margin of optimization, and clearly indicative of a vastly different process and theory of operation (i.e., the use of saturated solution-phase ozone in the case of the cited references to achieve contact and transport of the oxidant, compared to the transport and action of ozone *bubbles*, which are trapped localized free gas, on the wafer surface). In particular, this section of the MPEP also clearly states that "A *prima facie* case of obviousness may also be rebutted by showing that the art, in any material respect, teaches away from the claimed invention. *In re Geisler*, 116 F.3d 1465, 1471, 43 USPQ2d 1362, 1366 (Fed. Cir. 1997). As discussed extensively above, the actual method of removal of photoresist from the surface to be stripped in Muraoka is accomplished by a saturated ozone solution, but is accomplished as claimed in Applicants instant Claim 4 by "a stripping composition including an acetic acid and an ozone gas included in the acetic acid *in the form of a bubble*". These are completely different stripping solutions, with completely different accompanying stripping methods and principles of operation, and consequently the teachings of Muraoka must be appreciated to be being materially different from the claimed process. There can therefore be no reasonable expectation that combining these references, and further modifying the references to include ozone in bubble form, would have a reasonable expectation for success. Applicants respectfully request the Examiner reconsider the rejection of Claim 4 over Muraoka, and withdraw the rejection.

Thus for at least the above reasons, Muraoka fails to teach all limitations of the instant claims, fails to provide a suggestion or incentive that would lead one skilled in the art to modify the combination of references to provide the invention of Claim 4, and fails to provide a

reasonable expectation for success for the combination. Muraoka therefore fails to render Claim 4 and its dependents unpatentable. Reconsideration and allowance are respectfully requested.

Claims 11 and 12 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over Muraoka in view of U.S. Patent Application Publication No. 2003/0045037 ("Mei"). Applicants respectfully traverse this rejection.

Mei discloses a memory device having thin-film transistor memory cells with gate electrodes, which comprise Al/Cr. FIG. 11, ref. numeral 506.

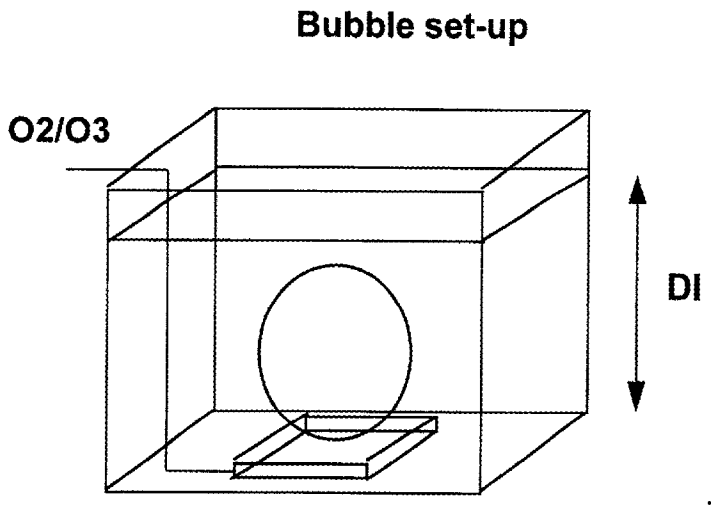



Mei discloses a CVD/PECVD deposition processes (e.g., [0094]), but is silent as to stripping process of Claim 4 and is in particular silent as to stripping compositions comprising acetic acid comprising ozone bubbles or to pH of the stripping composition, as claimed in the instant claims, and thus for reasons disclosed hereinabove, fails to remedy the deficiencies of Muraoka. Thus, the combination of Muraoka and Mei fails to render the instant claims unpatentable.

Claims 13-15 stand rejected under 35 U.S.C. § 103(a), as allegedly unpatentable over Muraoka in view of Mei, and further in view of U.S. Patent Application Publication No. 2002/0088478 ("Degendt"). Applicants respectfully traverse this rejection.

Degendt discloses inclusion of chlorine in a stripping process. (e.g., Degendt, [0014], [0016], [0080]). Degendt discloses a method of removing organic impurities, such as photoresist, from a semiconductor device. A composition for removing the organic impurities includes ozone

and acetic acid. The setup is as shown in the Abstract and exemplary drawing:




However, Degendt is silent as to stripping process of Claim 4 and is in particular silent as to stripping compositions comprising acetic acid comprising ozone bubbles as claimed. Furthermore, modifying Muraoka to use the bubbling process of Degendt would change the principle of operation of Muraoka as discussed above, where Muraoka is exclusively drawn to a saturated solution and not a bubbling or effervescent solution, and therefore for the same reasons as above, modifying Muraoka to include bubbles and the very high (>80,000 ppm) ozone concentration of the instant claims would both change the principle of operation of Muraoka and render it unsuited to its intended purpose (e.g., where there is no suggestion either of the apparatuses of FIGs. 1 or 7 would function as intended with the method of Degendt included); and thus for reasons disclosed hereinabove, Degendt fails to remedy the deficiencies of Muraoka or Muraoka and Mei. Thus, the combination of Muraoka, Mei and Degendt fails to render the instant claims unpatentable.

Conclusion

It is believed that the foregoing amendments and remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and allowance are requested.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130.

Respectfully submitted,

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